INVESTIGATOR'S ANNUAL REPORT

National Park Service

All or some of the information provided may be available to the public

Reporting Year: 2005	**Park:** Shenandoah NP
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Permit#:
SHEN-2004-SCI-0022

Park-assigned Study Id. #:
SHEN-00307

Project Title:
Investigation of Phenology as an Indicator of Climate Change in the Blue Ridge Ecoregion encompassing Shenandoah National Park

Permit Start Date: Jan 01, 2005	**Permit Expiration Date** Dec 31, 2009
Study Start Date: Jan 01, 2005	**Study End Date** Mar 31, 2008

Study Status:
Continuing

Activity Type:
Research

Subject/Discipline:
Geography

Objectives:

Forests in the Blue Ridge region are undergoing numerous changes due to land cover/land use change, successional processes and disturbances due to defoliating insects, air pollution, and fire. Global- or regional-scale climate changes may be compounding the disturbance regime and may have dramatic consequences to Appalachian mountain ecosystems. Vegetation phenology can be used to track changes in climate and measurements can be scaled from field observations to regional patterns evidenced in satellite imagery. We propose to investigate whether changes in phenology are evident in Shenandoah National Park through the use of time sequenced satellite imagery, field investigations, and spatial modeling. We will investigate the patterning of phenological events due to topographic influences and model potential changes to forest community composition over time.

Findings and Status:

The project began in the spring of 2005. During the period of 3/05 through 12/05 we focused on designing and placing meteorological stations, initial meteorological data collection, and image acquisition planning for database development. Using a Geographic Information System, locations close by sensitive areas and trails were excluded from potential use. Then points were randomly cast throughout the Park as a function of slope, aspect, and forest cover types, so that a variety of elevations, aspects, and forest communities were represented. Once these points were approved by the NPS, a subset of 6 point locations were selected, named, and visited to determine their suitability and document appropriate routes to access them. Five stations were set up to monitor air temperature, relative humidity, and soil temperature. One station was established to monitor air temperature, relative humidity, soil temperature (at two depths), incoming and up-welling radiation, wind speed, wind direction, and rainfall. In the first year, data retrieval was only possible by visiting each site on a roughly quarterly time-scale for download to portable computer. Unfortunately, several long gaps in the data record for particular stations occurred due to station equipment damage caused by human vandalism or bear activity. We placed small notices on the stations

explaining their purpose with the hope that additional vandalism will be avoided. We have not yet formulated a suitable way to deter bears from climbing the stations and chewing on various meteorological sensors. Preventing station damage and developing capabilities for automated data download (that will allow us to quickly see when particular stations have been rendered inoperative) will be important objectives for 2006. In 2005 we also began developing a temporally extensive database of moderate resolution imagery for the Shenandoah National Park and surrounding area. Imagery to be used for this project includes Advanced Very High Resolution Radiometer (AVHRR), Landsat Thematic Mapper (TM), and Landsat Enhanced Thematic Mapper (ETM+) data. In 2005, composite AVHRR normalized difference vegetation index (NDVI) time series data for 1989 - 2004 were acquired. They were processed to derive numerous phenologic metrics (e.g., start of season, end of season, duration of growing season, rate of green up, seasonal maximum NDVI, and seasonal minimum NDVI). While some Landsat TM data were acquired, the primary 2005 focus for Landsat TM data acquisition was the search and screening of archived imagery to determine what image scenes meet minimum quality requirements (e.g., minimal cloud cover) and create the best opportunities to develop intra-annual phenologic information from TM. We visually screened the entire Landsat archive and identified over 200 suitable quality TM scenes spanning the 1985 to 2005 period. These scenes were prioritized so that the best and most important scenes may be acquired as additional funds become available.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

No

Funding provided this reporting year by NPS:	**Funding provided this reporting year by other sources:**
0	25000

Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:	**Annual funding provided by NPS to university or college this reporting year:**
n/a	0